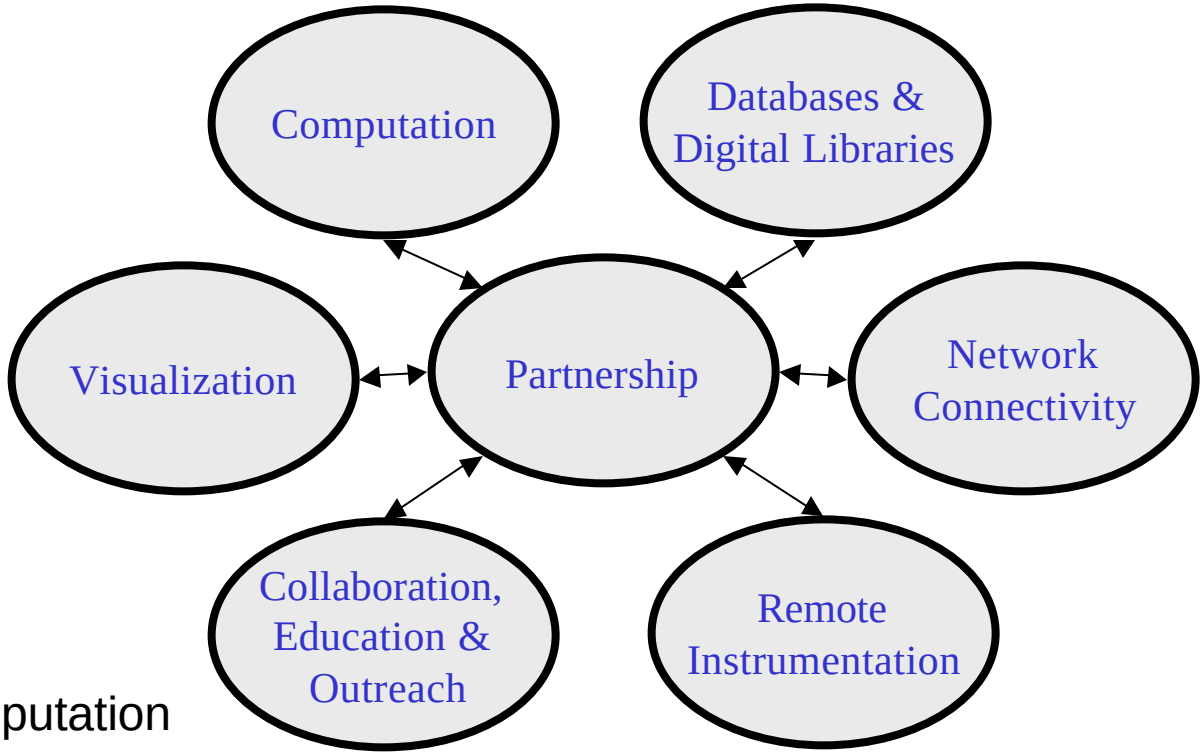
Telescience for Advanced Tomography Applications

Steven Peltier
Mark Ellisman, Ph.D.
University of California, San Diego

- Description of the Telescience Project
- Telescience Portal Architecture
- Telescience Applications
- The IGRID Collaboration

Vision of Telescience



- Telemicroscopy
- Globus Enabled Computation
- Advanced Visualization
- Advanced Networking
- SRB Enabled Access to Distributed/Federated Databases
- Environment that Promotes Collaboration, Education and Outreach

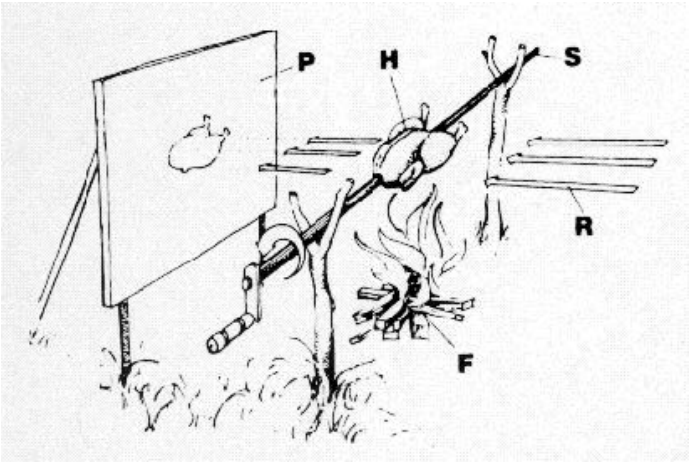
Electron Tomography

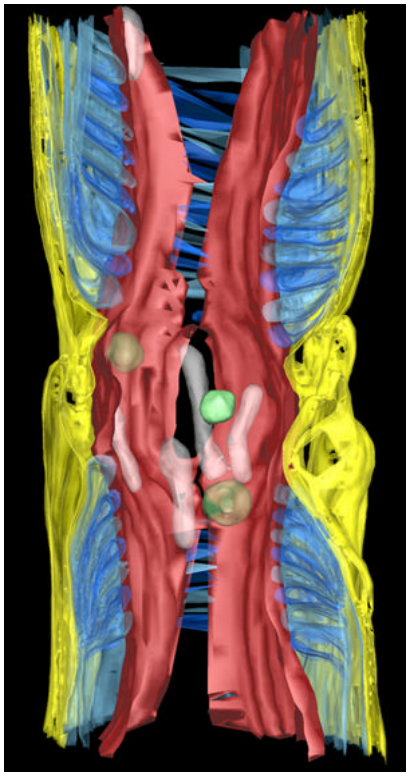
Derive 3D information about a sample from a series of 2D projections

Perfect application for driving the integration of technologies:

- Computation and data intensive
- Requires increased access to unique, expensive instrumentation
- Requires advanced visualization tools for segmentation and analysis of the data
- Detailed process well suited for collaboration
- Demand from neuroscience community for accelerated population of databases of biological structure

IVEM





3D Model of the Node of Ranvier

The Telescience Portal

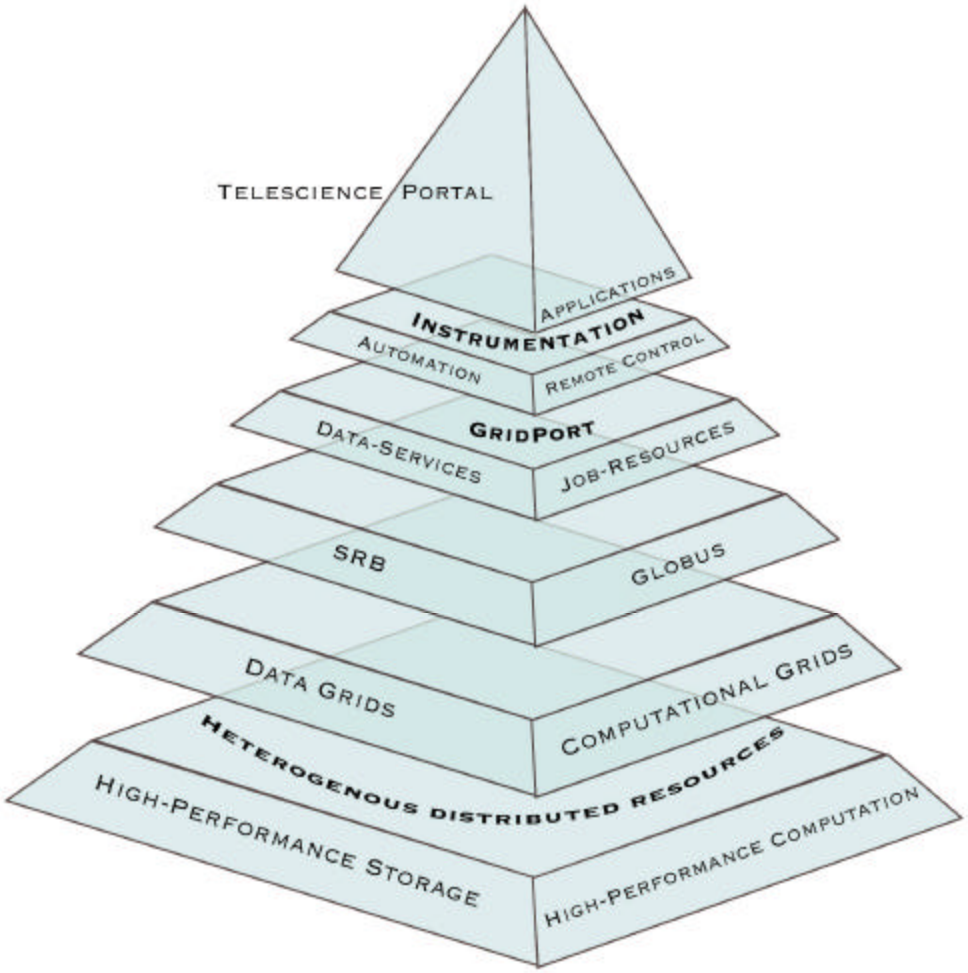
https://gridport.npaci.edu/Telescience

Application environment that provides centralized access to **ALL** tools/applications necessary for electron tomography with a **Single Login** from any Internet capable location

Provides simple, intuitive access to sophisticated instrumentation and Grid resources for data storage and computation

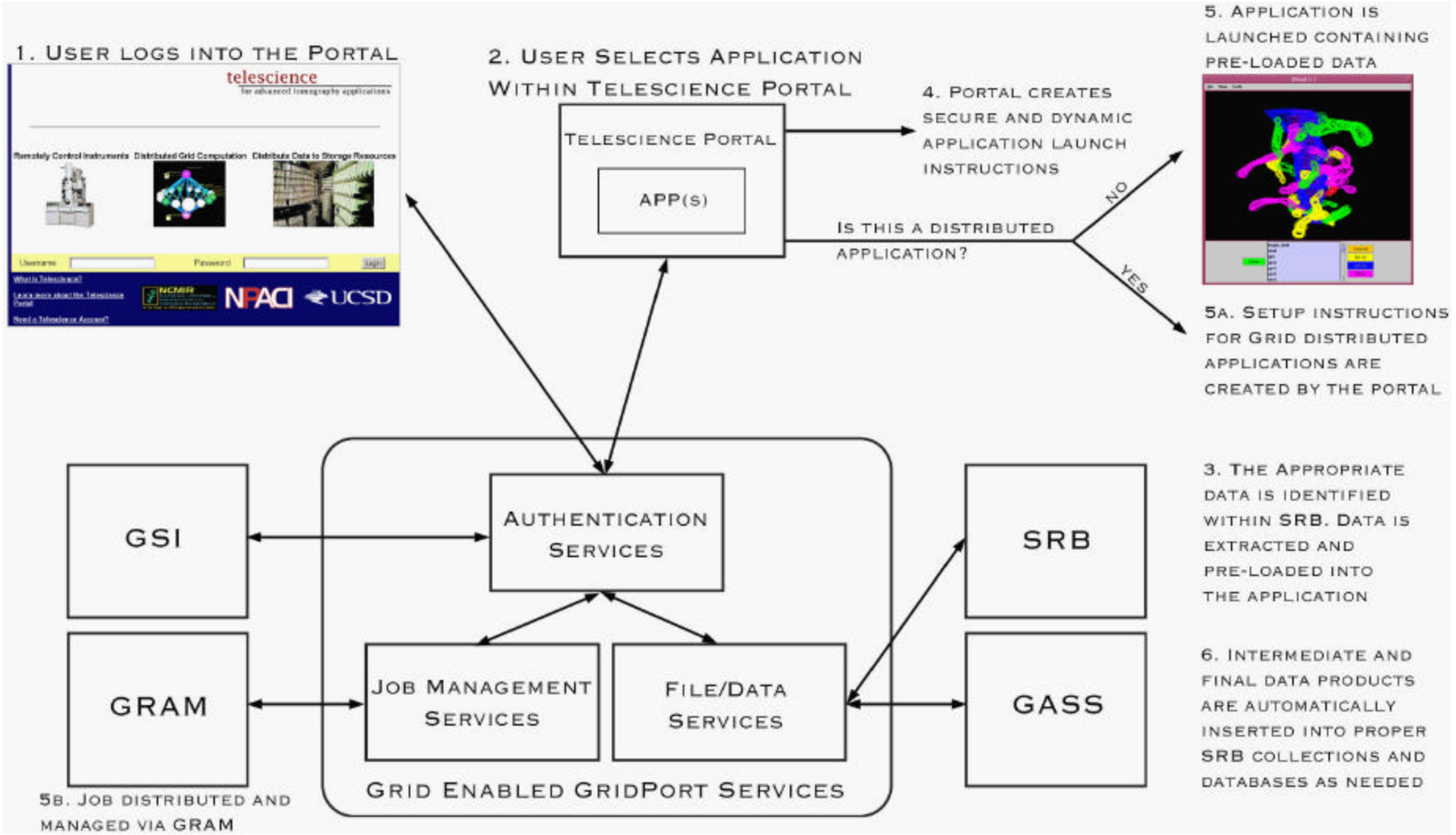
Provides a framework for future needs of high-throughput electron tomography

Telescience Architecture



- Telescience Portal is composed of many “layers”
- Layers are modular, allowing for extension of each layer without disrupting the entire system
- Every Layer has its own complexity and administration that was previously passed on to the end-user
- Telescience Portal centralizes all administrative details of each layer into a single username and passphrase

Grid Services

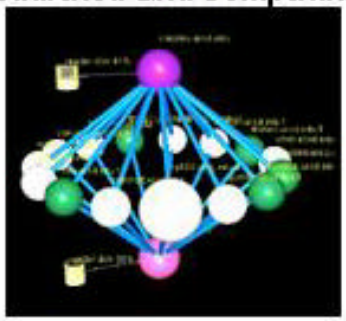


Login Page

telescience
for advanced tomography applications

Remotely Control Instruments

Distributed Grid Computation



Distribute Data to Storage Resources

Username Password Login

What is Telescience?

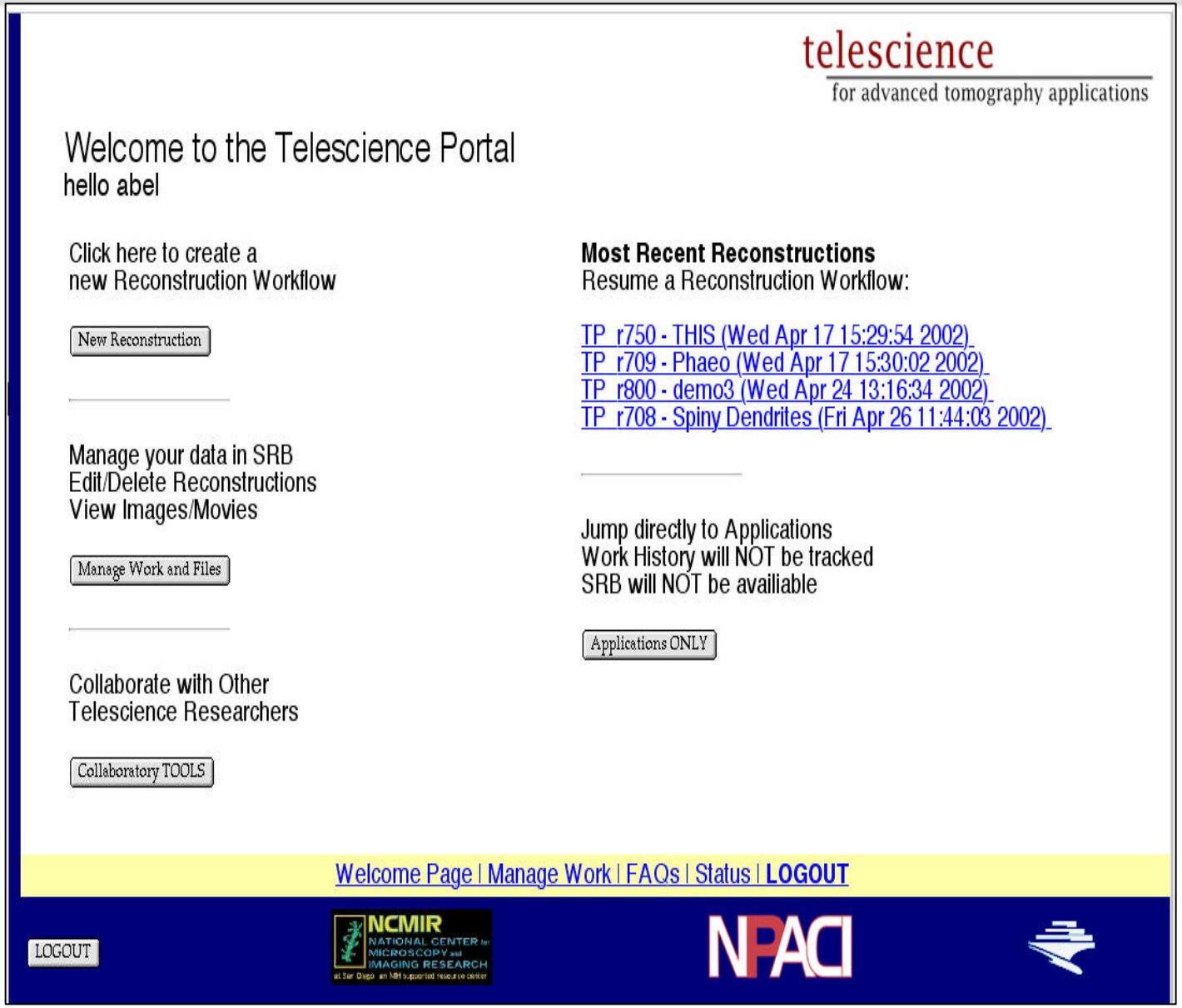
Learn more about the Telescience Portal

Need a Telescience Account?

NCMIR NATIONAL CENTER for MICROSCOPY and IMAGING RESEARCH at San Diego, an NIH supported resource center

NPACI UCSD

Welcome Page

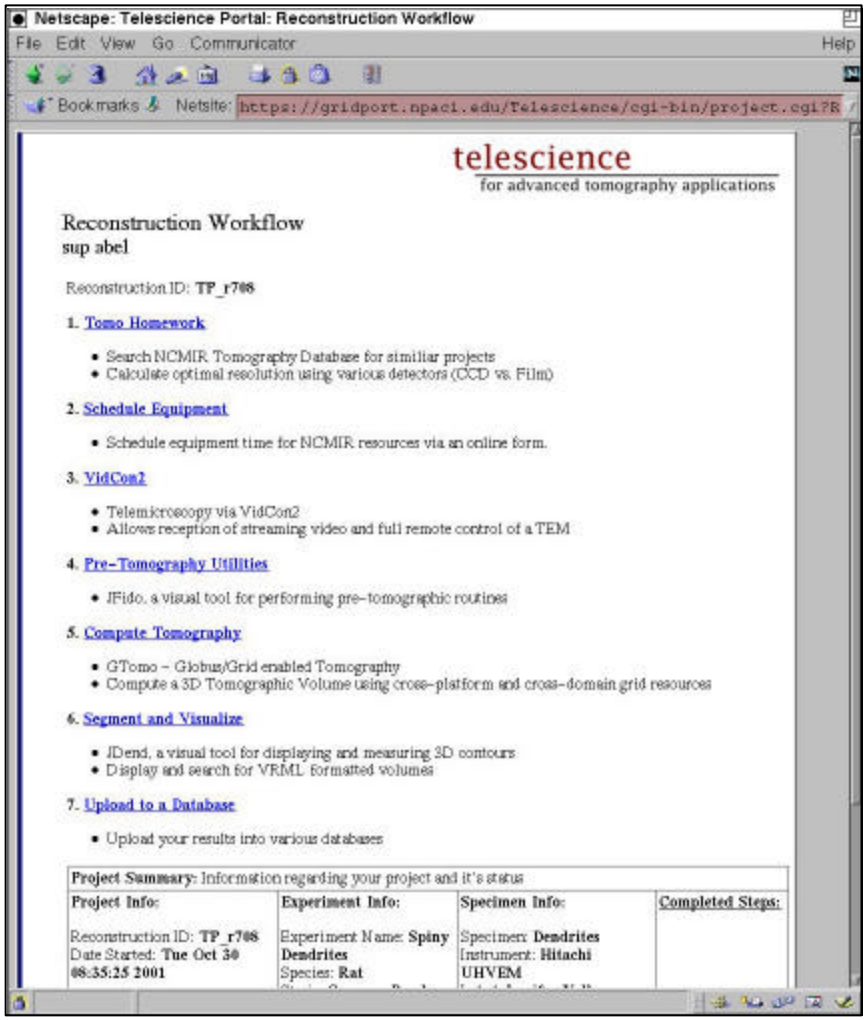


Tomography Workflow

Sequence of steps required to acquire, process, visualize, and extract useful information from a 3D volume.

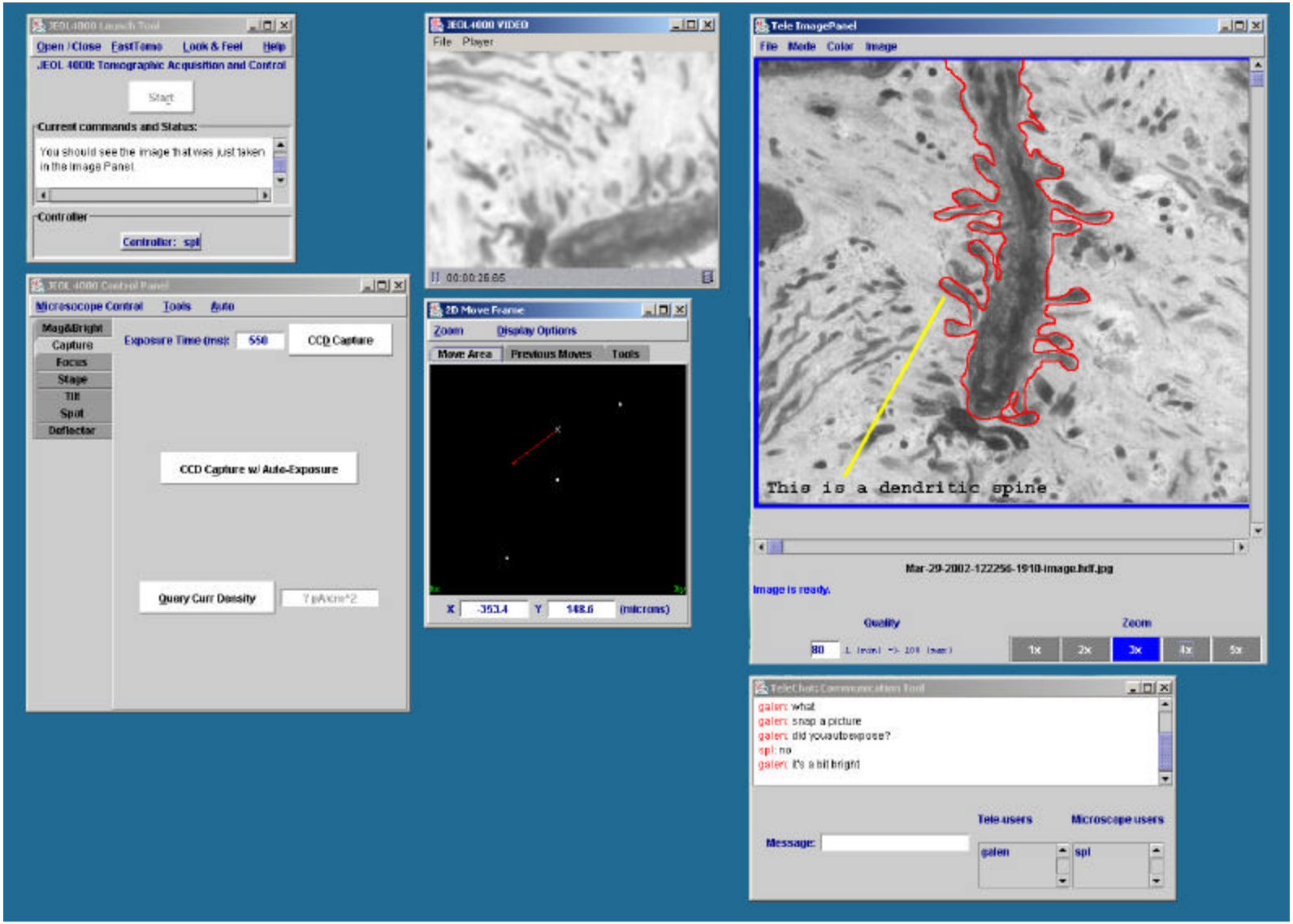
•Problems with non-Portal “traditional” workflow:
- (~20) heterogeneous and platform specific tools:
  - Simple shell scripts
  - Parallel Grid enabled software
  - Commercial software
- Administration is responsibility of the user
- Manual tracking, handling of data

• Advantages of workflow managed by Telescience Portal:
- Progress through the workflow can be organized and tracked
- Automated and transparent mechanisms for the flow of data
- Centralize tools and enhance operations with uniform GUIs to improve usability

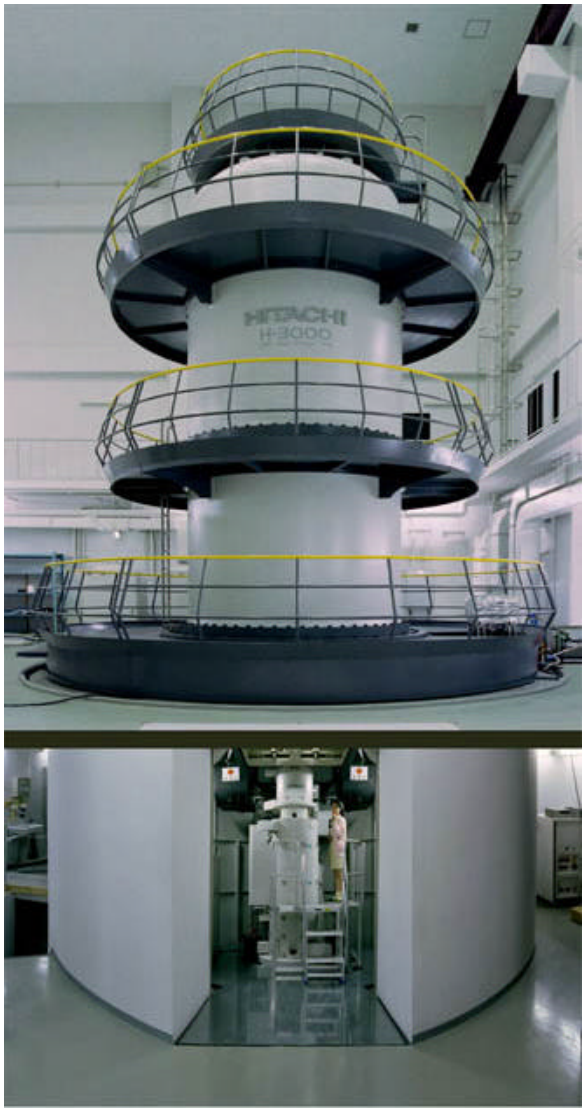


Telemicroscopy via VidCon2

telescience
for advanced tomography applications



High Quality Digital Video over IPv6

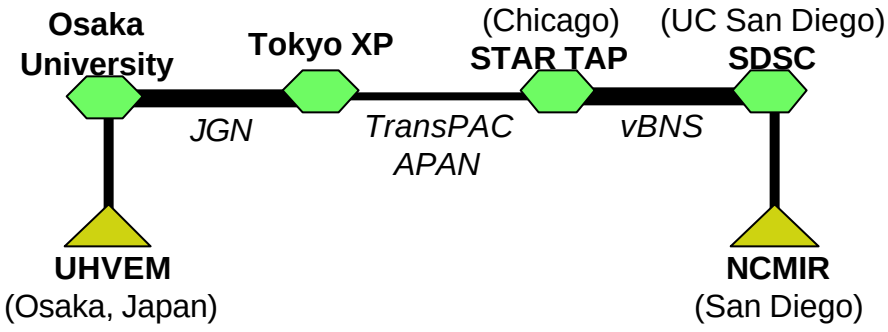


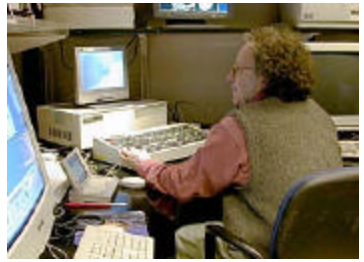
Continuing research with collaborators in Osaka, Japan who are interested in latest technologies for sending high resolution digital video over next generation Internet protocols

Remote access to 3 MeV microscope at Osaka University

Advantages for Digital Video over IPv6:

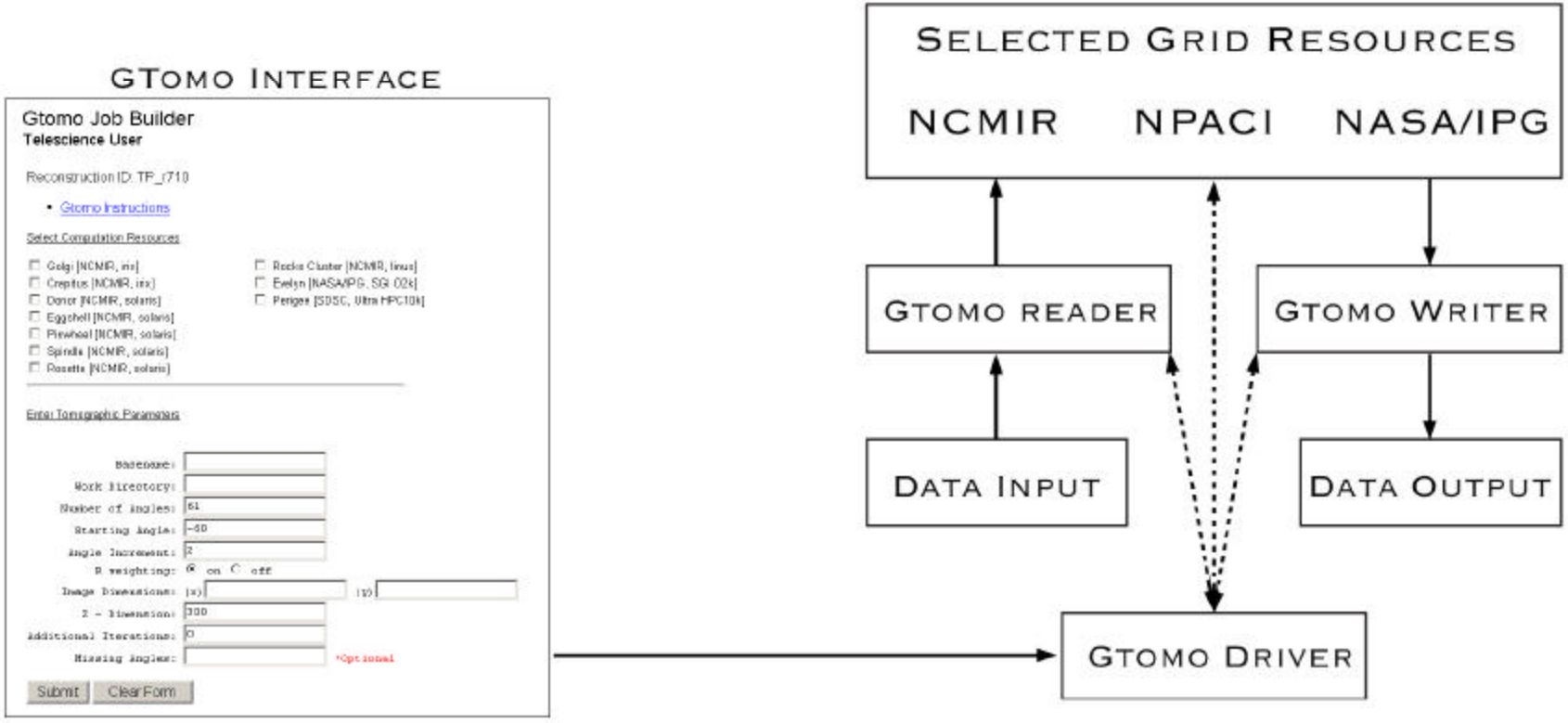
- interactive video; 40Mbps and increasing, 30 fps
- quality of service
- improved security
- enhanced multicasting ability





Globus Enabled Tomography (Gtomo)

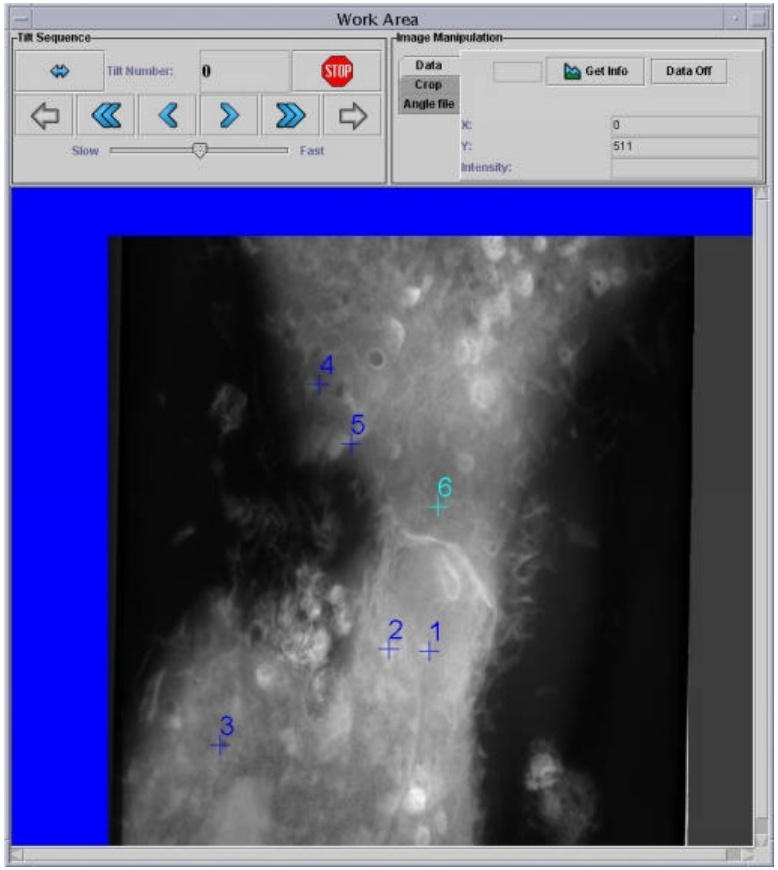
telescience
for advanced tomography applications



- Complete Abstraction of Grid
- No need to manage Globus Certificates
- Simply click resource(s) to use and enter biological parameters
- Resources are transparently cross-platform, cross-domain

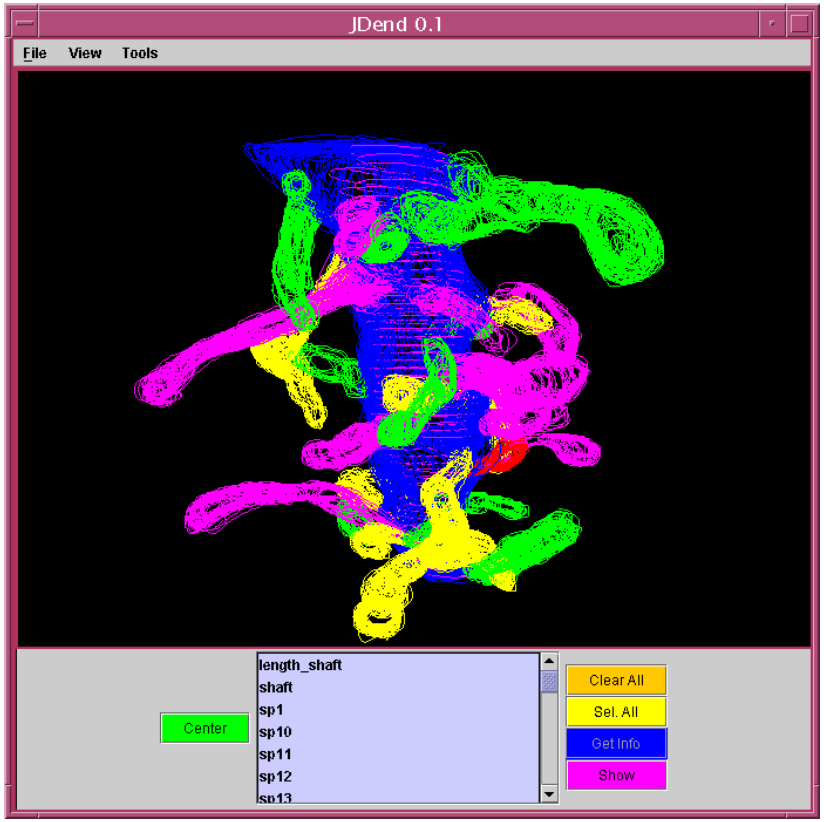
Image Processing

JFido



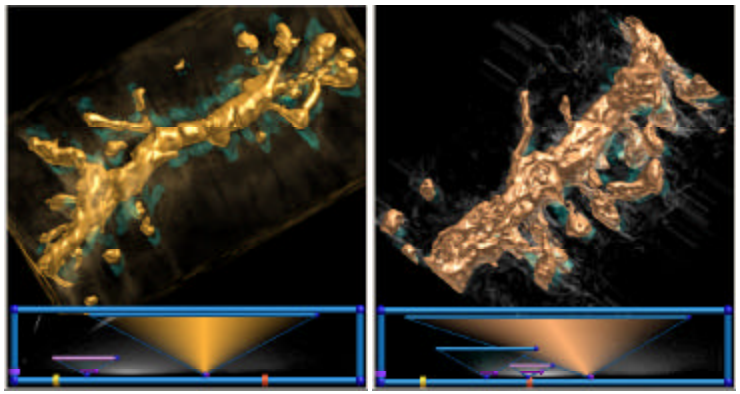
Pre-processing Utilities (ie. Fiducial marking, cropping, normalization) general 2D image viewer

JViewer

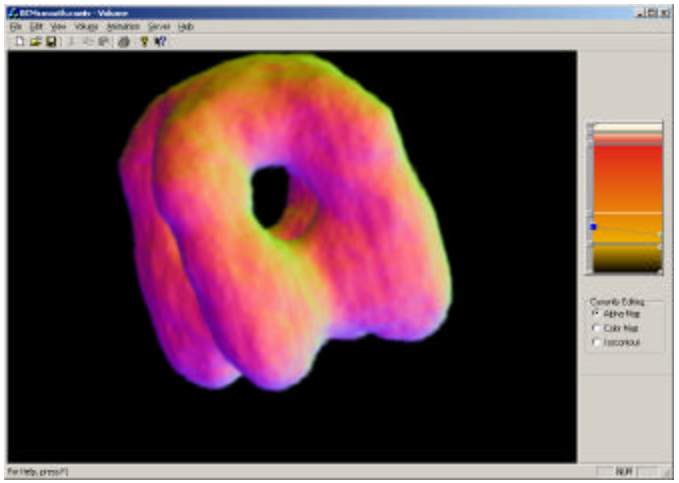


3D contour visualization morphological measurements

Advanced Visualization Technologies

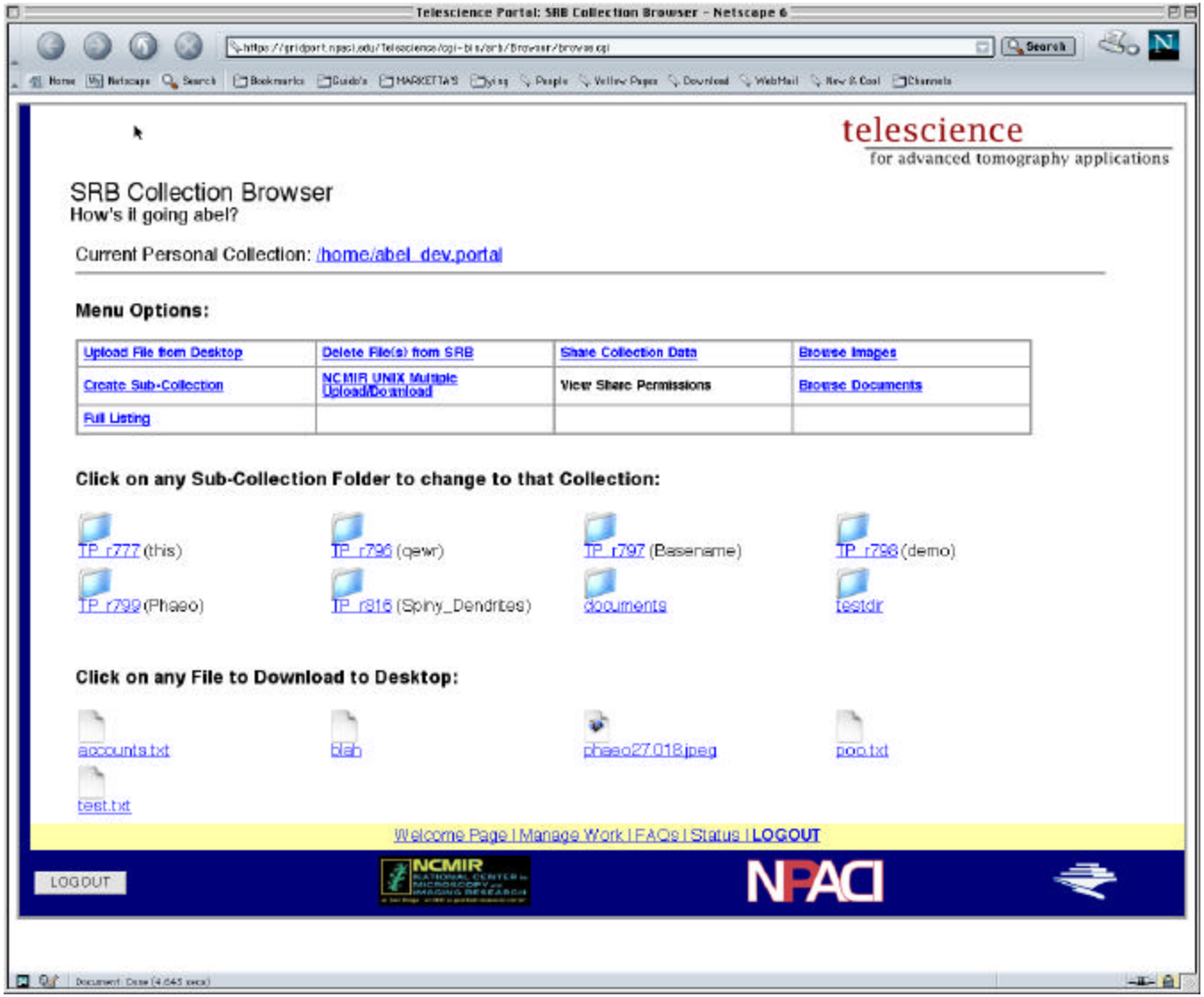


Real-time interactive volume rendering with 2D transfer functions. Users can query data, define new opacity functions, and modify properties in real
University of Utah Scientific Image and Computing Institute
(http://www.sci.utah.edu/)



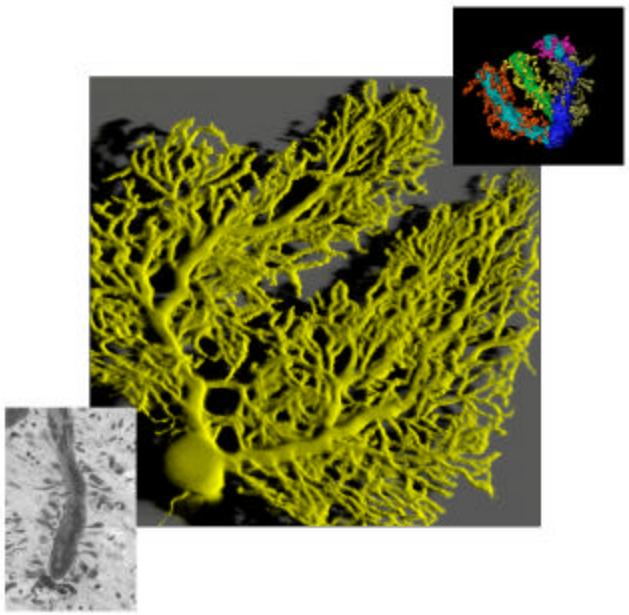
Synchronous client-server based visualization tool for volume rendering
Center for Computational Visualization at the University of Texas
(http://www.ticam.utexas.edu/CCV/)

SRB Collection Browser

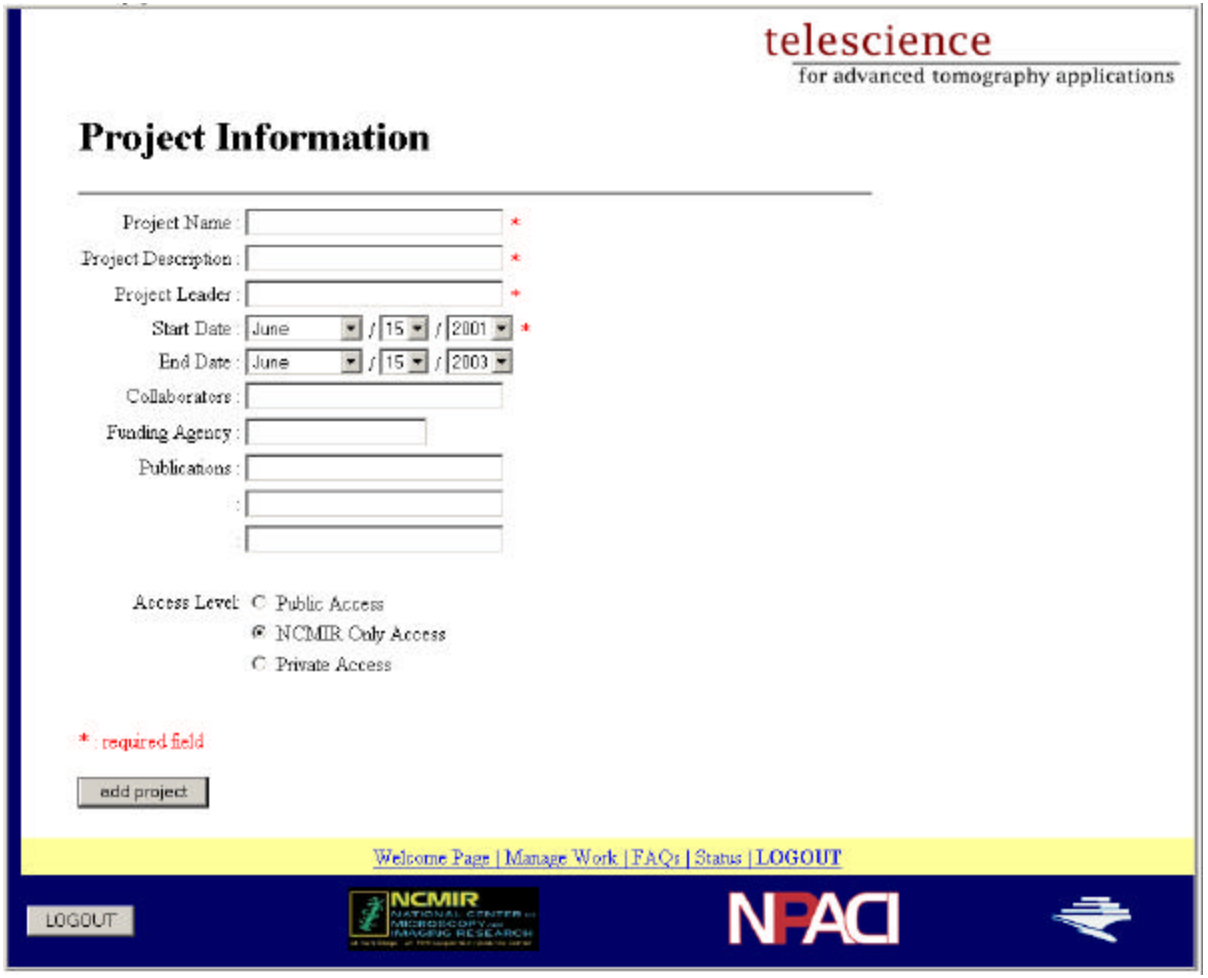


CCDB and Telescience

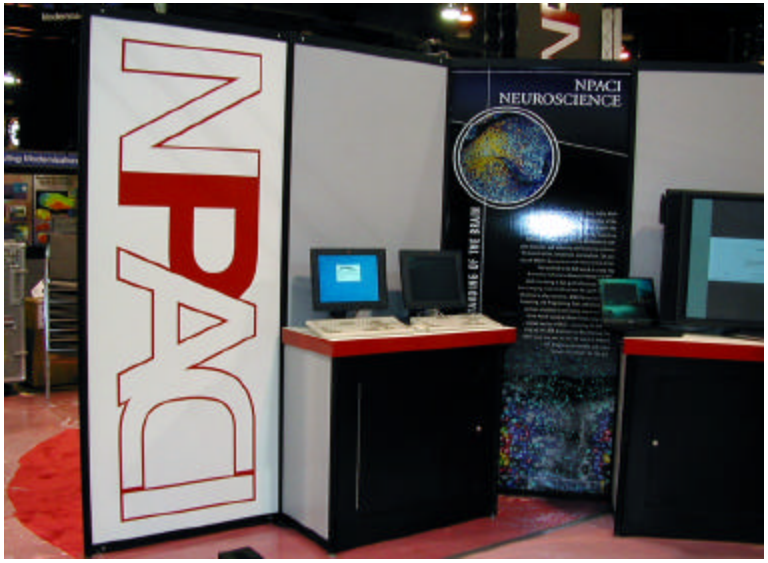
- Automated data entry into a database.
- Integration with SRB.
- Advanced query interface under development.

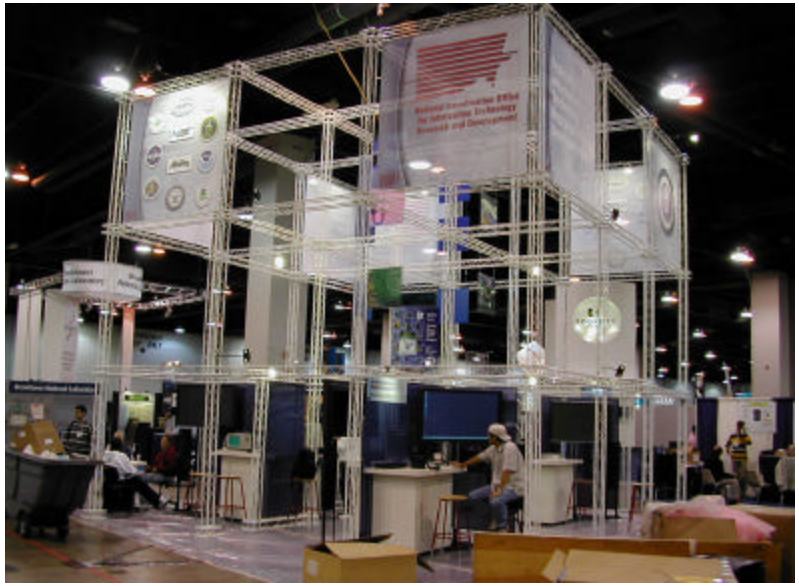


Cell Centered Database



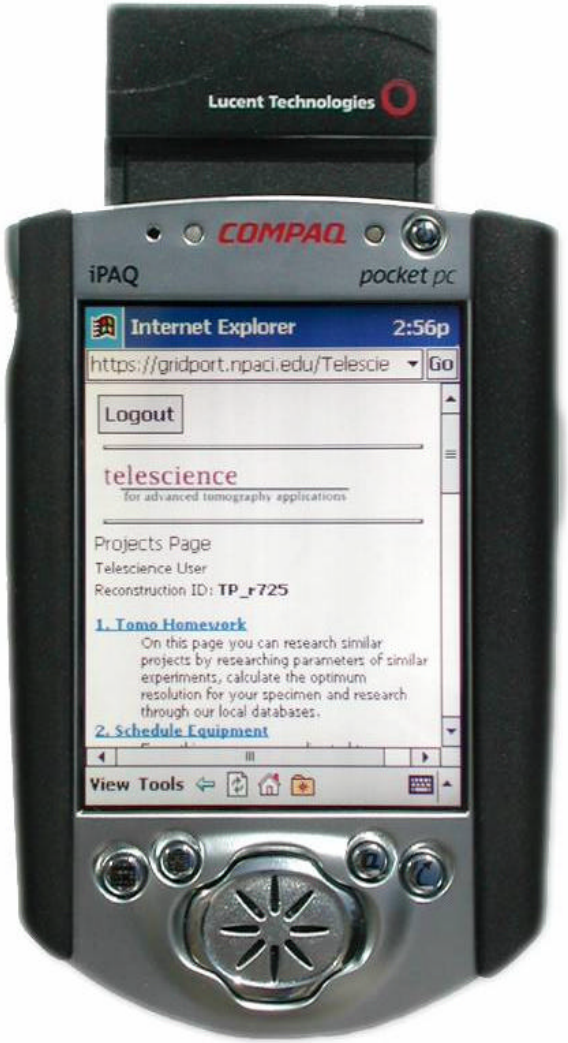
Telescience and the Classroom





Wireless Access

- Web based technologies lets us take advantage of commodity technologies.
- Anywhere, anytime access.
- Uniform Internet interface.



Demonstrate Advanced features of the Telescience Portal:

1. Perform Telemicroscopy controlling the IVEM at NCMIR and the UHVEM at Osaka University.
   -Digital Video is broadcast at 30fps over a dedicated IPv6 network between San Diego and Amsterdam as well as between Osaka and Amsterdam.
2. Data will be computed with distributed resources within NCMIR, NPACI, NCHC, and Osaka University.
3. Render and visualize data in Amsterdam using distributed resources in NCHC.

Acknowledgements

Telescience Participants:

- Telemicroscopy and Project Integration: National Center for Microscopy and Imaging Research
- Globus: Information Sciences Institute, University of Southern California
- GridPort: San Diego Supercomputer Center; Texas Advanced Computing Center
- Storage Resource Broker (SRB): San Diego Supercomputer Center
- Cell-Centered Database: University of California San Diego, Montana State University
- Interactive Collaboration Environments: Center for Computational Visualization, University of Texas
- Application-Level Scheduling (AppLeS) and Network Weather Service (NWS): University of California San Diego, University of California Santa Barbara

International Collaborators:

- Advanced Networking and Computation: Cybermedia Center, Osaka University, Japan
- 3 MeV Microscopy: Center for UHVEM, Osaka University, Japan
- Visualization and Computation: National Center for High-Performance Computing (NCHC), Taiwan